9. (Not Amended) A printed wiring board as claimed in claim 1, wherein the inserted component is soldered onto said substrate by flow soldering using lead-free solder.

Sub Bill A19

10. (Amended) A printed wiring board as claimed in claim 9, wherein the lead-free solder contains Bismuth.

11. (Not Amended) An electronic apparatus in which is installed a printed wiring board as claimed in claim 1.

REMARKS

Applicants request reconsideration and allowance of the present application in view of the foregoing amendments and the following remarks.

Claims 1 and 3-11 are pending in the present application. Claim 1 is the sole independent claim. Claim 2 has been cancelled without prejudice. Claim 11 stands withdrawn from consideration.

Claims 1, 5-8, and 10 have been amended. No new matter has been added.

Initially, Applicants respectfully traverse the restriction requirement set forth in the Office Action. In the Office Action, it has been stated that the inventions of Group I (Claims 1-10) and Group II (Claim 11) are patentably distinct from each other for various reasons. However, per MPEP § 803, if a search and examination of an entire application can be made without serious burden, it must be examined on its merits. Because the claims have already been searched and examined, it is respectfully submitted

that there can no longer be any serious burden. Further, Applicants respectfully submit that the various groups of claims are closely related and that a proper search of any of the claims of one group would likely include a search of the claims of the other group. Thus, it is submitted that all of the claims can be searched simultaneously and that a duplicative search with possibly inconsistent results may occur if the restriction requirement is maintained. Therefore, in the interest of economy, both for the Office and Applicants, withdrawal of the restriction requirement is respectfully solicited.

Nevertheless, in order to comply with the requirements of 37 CFR 1.143, Applicants provisionally elect the claims of Group I, namely Claims 1-10.

The Office Action objected to the specification on formal grounds. By the present Amendment, Applicants have amended the specification in a manner believed to address this objection, as well as to improve its idiomatic English form. Favorable consideration is requested.

Claims 5, 6, 8, and 10 stand rejected under 35 U.S.C. §112, second paragraph, as indefinite. By the present amendment, while not conceding the propriety of this rejection, and solely to expedite prosecution, Applicants have amended Claims 5, 6, 8, and 10 in a manner believed to obviate this rejection. Accordingly, Applicants respectfully submit that Claims 5, 6, 8, and 10 now even more fully satisfy the requirements of 35 U.S.C. §112, second paragraph, and request favorable reconsideration and withdrawal of this rejection.

Claims 1-5, 7, and 8 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 3,610,811 (O'Keele). Claims 1-10 stand rejected under 35

U.S.C. § 103(a) as being unpatentable over O'Keele in view of U.S. Patent No. 5,730,932 (Sarkhel, et al.). These rejections are respectfully traversed.

Independent Claim 1 recites, inter alia, means for maintaining a connection portion between the surface of each of a plurality of lands to which a wiring pattern is connected and the wiring pattern in a state not wetted by solder.

By this feature, as explained at page 12, lines 14 through 27 of Applicants' disclosure, the breakage of the wiring pattern caused by stress on the lands during soldering can be prevented. In addition, the strength of the interface between an inserted component and the substrate can be maintained. As a result, advantageous performance can be attained.

O'Keele relates to a printed circuit board with solder resist gas escape ports and teaches that at least a portion of the circuit board surface is covered with a solder resist along the perimeter of each plated through hole.

Sarkel, et al. relates to lead-free, tin-based multi-component solder alloys and teaches an alloy that includes tin, silver and bismuth.

However, Applicants respectfully submit that neither O'Keele nor Sarkel, et al., either alone or in combination, assuming, arguendo, that these documents can be combined, teaches or suggests at least the aforementioned feature of independent Claim 1.

For the foregoing reasons, Applicants submit that the independent claims patentably define the present invention over the citations of record. Further, the dependent claims should also be allowable for the same reasons as the base claims from which they depend and further due to the additional features that they recite. Separate and individual consideration of each of the dependent claims is respectfully requested.

Applicants believe the present Amendment is responsive to each of the points raised by the Examiner in the Official Action and submits that the present application is in allowable form. Favorable consideration of the claims and passage to issue of the present application at the Examiner's earliest convenience earnestly are solicited.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,

Attorney for Applicants
Michael E. Kondoudis
Registration No. 42,758

FITZPATRICK, CELLA, HARPER & SCINTO
30 Rockefeller Plaza
New York, New York 10112-3801
Facsimile: (212) 218-2200
MEK:cmv
DC_MAIN 118513 v 1

VERSION WITH MARKINGS TO SHOW CHANGES MADE TO THE SPECIFICATION

Paragraph at page 1, lines 8 to 15 has been amended as follows:

--This invention relates to a printed wiring board [a printed wiring board] which is capable of preventing the occurrence of lift-off and land peeling at soldered portions when a component to be mounted on the printed wiring board (hereinafter referred to as the ['inserted component')] "inserted component" is soldered by using solder, in particular lead-free solder, and an electronic apparatus such as a printer in which is installed the printed wiring board.--

Paragraph at page 1, lines 18 to 22 has been amended as follows:

--Soldering has conventionally been carried out using eutectic lead solder (Sn-Pb: melting point [183ºC] 183°C), but in recent years there have been demands for soldering to be carried out using lead-free solder due to environmental restrictions.--

Paragraph at page 1, line 23 to page 2, line 9 has been amended as follows:

--However, the high-temperature-type lead-free solders that are currently most commonly used are composed mainly of Sn and Ag, and have a melting point of about [220ºC] 220°C. If flow soldering of an inserted component is carried out using such a high-temperature-type lead-free solder, then solidification of the solder, which is accompanied by solidification shrinkage, proceeds from the vicinity of the inserted component, which has good thermal conductivity, towards the vicinity of the printed wiring board, and hence the solder

joint interface at the part of the surface of the substrate on which the inserted component is mounted in particular becomes the final solidified part, resulting in lift-off and land peeling.--

Paragraph at page 2, lines 10 to line 21 has been amended as follows:

--Moreover, when flow soldering is carried out using lead-free solder as described above, segregation of Pb contained in the surface-treated leads of the inserted component and segregation of elements ([Bi] Bismuth, etc.) contained in the lead-free solder used in the flow soldering occur during the cooling process, and the physical properties of the solder [change] changes during the cooling process. As a result, there is a problem that the occurrence of lift-off and land peeling is increased, and in the worst cases the land peeling is accompanied by breakage (i.e., electrical disconnection) of the pattern connected to the lands.--

Paragraph at page 4, lines 14 to 27 has been amended as follows:

--To attain the above object, the present invention includes a printed wiring board comprising a substrate having two opposite surfaces, a plurality of soldering through holes formed in the substrate [so as to open in the opposite surfaces], for inserting leads of an inserted component to be mounted onto the printed wiring board and soldering the inserted component onto the substrate, each of the through holes having an inner peripheral surface, and a plurality of lands each formed continuously across the opposite surfaces and the inner peripheral surface of a corresponding one of the through holes, each land having a surface, and means for maintaining at least a part of the surface of each of the lands in a state not wetted by solder.--

Paragraph at page 5, lines 1 to 7 has been amended as follows:

--In a preferred form of the present invention, the printed wiring board further comprises at least one wiring pattern provided on at least one of the opposite surfaces and connected to the lands, and wherein the means maintains connection portions between the lands and the wiring pattern in a state not wetted by the solder.--

Paragraph at page 5, lines 12 to 13 has been amended as follows:

--Alternatively, the material not wetted by the solder is a [silk-printed] silk-screen pattern.

Paragraph at page 5, lines 14 to 16 has been amended as follows:

--Also alternatively, the material not wetted by the solder comprises a solder resist and a [silk-printed] silk-screen pattern laminated onto one another.--

Paragraph at page 5, line 26 has been amended as follows:

Please substitute the paragraph starting at page 5, line 26, with the following line. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

--More preferably, the lead-free solder contains [Bi] Bismuth.--

Paragraph at page 8, lines 11 to 19 has been amended as follows:

--In FIG. 1, a plurality of through holes 5 are formed in a substrate 1 of the printed wiring board, and a land 6 is formed over an inner peripheral surface of each through hole 5 and opposite end surface parts of the substrate 1 formed with [the] each through hole 5. Inserted component leads 2 of an inserted component 3 such as an electronic component are inserted into the through holes 5 and flow-soldered to the substrate 1 with lead-free solder.--

Paragraph at page 8, line 20 to page 9, line 6 has been amended as follows:

--A [silk-printed] silk-screen pattern 4 is formed on a major surface of the substrate 1 on which the inserted component 3 is mounted, so as to cover the lands 6 (specifically an end surface of each land 6 on the major surface side of the substrate 1) that are formed on the through holes 5 for soldering the inserted component 3 mounted on the substrate 1. Note that [silk-printed] silk-screen patterns (not shown in the drawings) that show the types, positions and numbers of components mounted on the substrate 1 and circuit diagram numbers are printed in predetermined positions on the major surface of the substrate 1, and the [silk-printed] silk-screen pattern 4 is printed at the same time as these [silk-printed] silk-screen patterns using the same ink.--

Paragraph at page 9, lines 7 to 13 has been amended as follows:

--As described above, a [silk-printed] silk-screen pattern 4 is interposed between the lands 6 and the inserted component leads 2 on the surface part of the substrate 1 on which the inserted component 3 is mounted. As a result, it is possible to carry out flow soldering such that fillets 7 are not formed between the inserted component leads 2 and the lands 6.--

Paragraph at page 9 line 24 to page 10, line 2 has been amended as follows:

--FIG. 2 shows a second embodiment of the present invention. The constitution of the printed wiring board in the present embodiment is the same as in the first embodiment, with one change that the lands 6 are covered with a solder resist 8 rather than a [silk-printed] silk-screen pattern 4.--

Paragraph at page 10, lines 19 to 24 has been amended as follows:

--FIG. 3 shows a third embodiment of the present invention. The constitution of the printed wiring board in the present embodiment is the same as in the first embodiment, with one change that the lands 6 are covered with both a [silk-printed] silk-screen pattern 4 and a solder resist 8.--

Paragraph at page 10, line 25 to page 11, line 4 has been amended as follows:

--Even with this constitution, similar to the case of the first embodiment, because the [silk-printed] silk-screen pattern 4 and the solder resist 8 are interposed between the inserted component leads 2 and the lands 6, it is possible to carry out flow soldering such that fillets 7 are not formed between the inserted component leads 2 and the lands 6.--

Paragraph at page 13, lines 9 to 13 has been amended as follows:

--Moreover, the leads of the inserted component may have already been treated with lead solder, the printed wiring board may be, for example, a double-faced printed wiring board or a multi-layered printed wiring board, and/or the lead-free solder may contain [Bi] Bismuth.--

VERSION WITH MARKINGS TO SHOW CHANGES MADE TO THE CLAIMS

1. (Amended) A printed wiring board comprising:

a substrate having two opposite surfaces, a plurality of soldering through holes formed in said substrate so as to open in said opposite surfaces, for inserting leads of an inserted component to be mounted onto the printed wiring board and soldering the inserted component onto said substrate, each of said through holes having an inner peripheral surface, [and] a plurality of lands each formed continuously across said opposite surfaces and the inner peripheral surface of a corresponding one of said through holes, each land having a surface, and at least one wiring pattern provided on at least one of said opposite surfaces and connected to said lands; and

means for maintaining [at least a part of] a connection portion between the surface of each of said lands to which said wiring pattern is connected and said wiring pattern in a state not wetted by solder.

5. (Amended) A printed wiring board as claimed in claim 3, wherein the material not wetted by the solder is a silk-screen [silk-printed] pattern.

6. (Amended) A printing wiring board as claimed in claim 3, wherein the material not wetted by the solder comprises a solder resist and a silk-screen [silk-printed] pattern laminated onto each other [one another].

7. (Amended) A printed wiring board as claimed in claim 1, wherein said means comprises deactivation treatment means for [of] oxidizing at least a part of the surface of each of said lands.

8. (Amended) A printed wiring board as claimed in claim 1, wherein lead solder is applied to the leads of the inserted component [have been treated with lead solder] prior to insertion of the inserted component.

10. (Amended) A printed wiring board as claimed in claim 9, wherein the lead-free solder contains Bismuth [Bi].